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Cleaning house. A burying beetle sanitizes a mouse carcass where larvae (*above*) will nest.

Mothering Beetles Suppress Microbes To Protect Food for Their Young

Over the centuries, people have learned to salt, smoke, chemically treat, and even irradiate food to protect it from the decay caused by microbes. Burying beetles also have good reason to ward off this kind of decay. These 1-centimeter-long insects raise their young in animal corpses, such as dead mice. The larvae feed off the flesh, so keeping this food microbe-free is crucial.

Burying beetle parents preserve their offspring's food store by coating these "nurseries" with antibiotic secretions, graduate student Andres Arce of the University of Manchester in the United Kingdom reported at the meeting. This behavior doubles the chances that the larvae will survive and reproduce. "The work nicely demonstrates a mechanism by which insect parents can defend against microbes and thereby enhance the environment in which offspring develop," says Mathias Kölliker, an evolutionary biologist at the University of Basel in Switzerland.

It also provides another example of the role microbes play in the evolution of larger organisms. Far too often, the idea of microbes as competitors for resources has been ignored, says Allen Moore, an evolutionary biologist at the University of Georgia, Athens. Yet their interactions with larger organisms are proving "more subtle and important than perhaps previously realized."

The beetle studies appear to support a proposal put forth in 1977 by Daniel Janzen of the University of Pennsylvania. He suggested that bacterial and fungal decomposers promote rotting to make meat and fruits unpalatable, or even toxic, to other consumers. In response, animals should evolve antimicrobial countermeasures, the ecologist said.

Daniel Rozen, Arce's adviser, began looking for evidence of this in the burying beetle *Nicrophorus vespilloides* several years ago. The beetle's nursery, a vertebrate carcass, is a relatively scarce resource. Once beetles locate a carcass, Rozen explains, the female cleans it, covering the flesh in secretions from her body. Newly hatched larvae wiggle their way into the putrefying flesh. During the next 6 days, the parents provide the larvae predigested carrion to supplement the larvae's own scavenging; then the larvae head off on their own.

In initial experiments, Rozen and his colleagues confirmed that microbes were a serious threat to beetle offspring. They provided the insects with either fresh or week-old mouse carcasses—where the microbes had presumably gained the upper hand. Larvae raised in the older carcasses grew more slowly, begged more for food, and ultimately were smaller and took longer to leave their nurseries.

Others had shown in test-tube experiments that burying beetle secretions can rupture bacterial cell walls. In a more real-life (or death) experiment, Arce showed for the first time that secretions collected from females tending a carcass kill bacteria. "Even diluted by a factor of 100, [the secretions] reduced bacteria from 100,000 to 1000 per milliliter," Arce reported. He also demonstrated that the killing activity was due to a lysozyme, an enzyme that breaks down bacterial cell walls.

It's not clear where the burying beetle gets its bacteria-fighting chemicals. A few social insects make their own antimicrobial compounds, but one wasp protects its larvae by cultivating antibiotic-producing bacteria in a special gland. As with the burying beetle tactics, these behaviors show that "there must be a strong selective force pushing the evolution of strategies by parents to counter microbes," says Clare Andrews, an evolutionary biologist at the University of Edinburgh in the United Kingdom. **–E.P.**

Tracing the Common Roots of Antibiotic Resistance

For Roy Kishony, the usual way to study the evolution of antibiotic resistance doesn't apply enough pressure. Typically, researchers expose bacteria to a given concentration of antibiotic over multiple generations. But Kishony, a systems biologist at Harvard University, wanted to know how the microbes would respond if he kept upping the ante, subjecting them to ever-greater doses of these drugs and forcing them to continue to evolve to survive. So he and his colleagues built a "morbidostat," a test tube–based system that automatically adjusts the amount of antibiotic delivered to keep in check the bacteria population growing in the tubes. Kishony has also looked at microbial evolution in the clinic, analyzing the genomes of more than 100 samples of a bacterium underlying a small infectious outbreak in cystic fibrosis patients.

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